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(First Revision)

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Indian Standard

METHOD OF HYDROGEN EMBRITTLEMENT TEST FOR COPPER

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 February 1985, after the draft finalized by the Methods of Physical Tests Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1971. In this revision the test requirements for assessment of hydrogen embrittlement by reverse bend test and microscopic examination have been brought in line with International Standard published on this subject.

0.3 In the preparation of this standard assistance has been derived from ISO 2626-1973 'Copper-Hydrogen embrittlement test' issued by the International Organization for Standardization.

1. SCOPE

1.1 This standard prescribes the method of hydrogen embrittlement testing of deoxidized and oxygen-free high conductivity coppers.

2. PRINCIPLE OF TEST

2.1 The test consists of preparation of a test piece and heating in an atmosphere containing hydrogen. If oxygen is present in the metal, reaction occurs which causes embrittlement. The test pieces is cooled out of contact with air. Embrittlement is then revealed by close bending or reverse bending or by microscopic examination.

3. TEST PIECES

3.1 Close Bend Test Piece — This shall be of a convenient length and either of the full section or of any convenient thickness or diameter not greater than 12 mm. Edges shall be rounded and smoothed. Test pieces not of the full section shall contain some part of the original surface of the material.

3.2 Reverse Bend Test Piece — This shall be of any convenient length and shall have a thickness or diameter not exceeding 2·5 mm. Edges shall be rounded and smoothed. Test pieces not of the full section shall contain some part of the original surface of the material.

3.3 Test Piece for Microscopic Examination — This shall be of any convenient size and shall include an outside surface of the material on at least one face.

4. EXPOSURE IN HYDROGEN

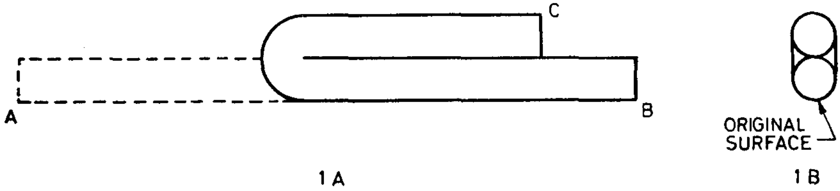
4.1 The test piece, prepared as above, shall be heated in a furnace with a reducing atmosphere containing not less than 10 percent of hydrogen by volume at a temperature between 825 and 875°C for a period of 30 minutes, and cooled in the furnace atmosphere or quenched in water.

5. TEST PROCEDURE

5.1 Close Bend Test — The bend test shall be carried out at ambient temperature. The test piece, *AB* in Fig. 1A shall be bent by steady pressure applied at right angles to the length, until the end *A* takes the position indicated by *C*. The original surface of the material shall be at the outside of the bend (Fig. 1B).

5.1.1 Bending shall be carried out in two stages. For the first stage, either of the methods specified in IS: 1599-1985* may be used to bend the test piece to a V-shape.

5.1.2 In the second stage, the two legs of the test piece shall be brought into contact by steady pressure applied across the open end of the *V*, for example, by closing in a vice. After bending, the stressed surface shall be visually inspected for the presence of cracks, if any.



1 A 1 B

FIG. 1 CLOSE BEND TEST

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*Method for bend test (*second revision*).

5.2 Reverse Bend Test — The test shall be carried out according to IS: 1716-1985*. The test piece shall be subjected to 10 reverse bends so that the original surface of the material shall be having the maximum stress. After bending, the stressed surface shall be inspected with the unaided eye, corrected for normal vision for the presence of cracks.

5.3 Microscopic Examination — The test piece shall be sectioned so that an outside surface is intersected at right angles. The section shall be polished, etched if desired, and examined under a microscope at a magnification of 200 × for evidence of gassing or open grain structure characteristic of embrittlement.

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*Method of reverse bend test for metallic wire (*second revision*).

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	$1\ \mathrm{N} = 1\ \mathrm{kg.\ m/s^2}$
Energy	joule	J	$1\ \mathrm{J} = 1\ \mathrm{N.m}$
Power	watt	W	$1\ \mathrm{W} = 1\ \mathrm{J/s}$
Flux	weber	Wb	$1\ \mathrm{Wb} = 1\ \mathrm{V.s}$
Flux density	tesla	T	$1\ \mathrm{T} = 1\ \mathrm{Wb/m^2}$
Frequency	hertz	Hz	$1\ \mathrm{Hz} = 1\ \mathrm{c/s}\ (\mathrm{s^{-1}})$
Electric conductance	siemens	S	$1\ \mathrm{S} = 1\ \mathrm{A/V}$
Electromotive force	volt	V	$1\ \mathrm{V} = 1\ \mathrm{W/A}$
Pressure, stress	pascal	Pa	$1\ \mathrm{Pa} = 1\ \mathrm{N/m^2}$

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